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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK
Volume 127
F-15A In-Flight Crew Noise

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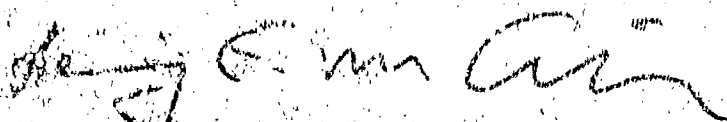
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FOR THE COMMANDER



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Director

Physiology and Biomechanics Division
Aerospace Medical Research Laboratory

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The F-15A is a USAF air superiority fighter. This report provides measured data defining the bioacoustic environments at the pilot's location inside this aircraft for 30 flight conditions. Data are reported for one location in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech interference level, perceived noise level, and limiting times for		

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total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing definitions of quantities, symbols, equations, applications limitations, etc.

PREFACE

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 723103, Crew Safety In Operational Noise Environments.

The author acknowledges the efforts of Mr. John N. Cole who established the data analysis requirements, Mr. Henry Mohlman and Mr. Fred Lampley of the University of Dayton who assisted in the mechanics of data processing and Mrs. Peggy Massie who typed this report and prepared it for publication.

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INTRODUCTION

The USAF F-15A is an air superiority fighter type aircraft manufactured by the McDonnell-Douglas Corporation St. Louis, Mo. Power is provided by two F-100-PN-100 (1) turbofan engines, manufactured by the United Aircraft Corporation, Pratt & Whitney Aircraft Division.

This volume provides measured data defining the bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the F-15A.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. *Refer to Volume 1* (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., in-flight flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published, and is available upon request from AMRL/BEE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of the updated index as it is generated.

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1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

IN-FLIGHT NOISE

MEASUREMENTS

All noise measurements were made on-board a F-15A aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard F-15A environments but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes).

Acoustic measurements were made inside the cockpit at the pilot's location. Table 1 lists the measurement location and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A, etc.

The microphone was attached to the pilot's helmet by means of a lightweight boom. This arrangement enabled adjustment of the microphone close to the ear level at a distance of 0.1 meter with its diaphragm parallel and facing away from the helmet's surface. In the analysis, microphone corrections for random incidence were applied to the overall systems response. The recorded samples were analyzed using a four or eight second integration time to obtain a power-averaged level which effectively smooths out short duration fluctuations and best describes the exposure.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the F-15A aircraft at the specified location. This table includes the overall, $\frac{1}{3}$ octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels, maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

TABLE 1
MEASUREMENT LOCATIONS AND TEST CONDITIONS

F-15A, Nellis AFB, 30 Jan 1979

LOCATION 1	POSITION Pilot, Left Side	HEIGHT ABOVE DECK Seated Head Level
CONDITION	DESCRIPTION	
A	Ground Runup - both engines idle, canopy closed, ECS Off	
B	Ground Runup - both engines idle, canopy closed, ECS On	
C	Ground Runup - both engines idle, canopy open	
D	Ground Runup - both engines 80% RPM, canopy closed, ECS Off	
E	Ground Runup - both engines 80% RPM, canopy closed, ECS On	
F	Ground Runup - both engines 80% RPM, canopy open	
G	Takeoff Climb to 10000' - Both Engines A/B	
H	Descent - 10000' → 5000'	
I	High Speed Run - 6000' AGL - 700 KIAS, 1.2 M	
J	Climb - 6000' → 15000' PA - 0.92 M	
K	Climb - 15000' → 20000' PA - 0.88 M	
L	Climb - 20000' → 25000' PA - 0.85 M	
M	Cruise - 25000' PA - 90% RPM - 0.95 M	
N	Cruise - 25000' PA - 1.0 M	
O	Cruise - 25000' PA - 340 KIAS, 1.2 M	
P	Cruise - 25000' PA - 380 KIAS, 1.35 M	
Q	Climb - 25000' → 40000' PA - Mil Power	
R	Cruise - 40000' PA - 0.95 M	
S	Cruise - 40000' PA - 1.2 M	
T	Cruise - 40000' PA - 460 KIAS 1.4 M	
U	Cruise - 40000' PA - 0.92 M	
V	Descent - 40000' → 19000' PA - speed brakes out	
W	Descent - 19000' PA → 320 KIAS	
X	Descent - 15000' PA - 350 KIAS	
Y	Descent - 10000' PA - 380 KIAS	
Z	Descent - 8000' PA - 350 KIAS	
AA	Air Combat Maneuver (ACM)	
BB	Initial - 1500'	
CC	360° Pattern - base to final turn, flaps and gears down	
DD	Landing Roll	

During all flight conditions the EC System was ON except where noted.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)															
1/3 OCTAVE BAND															
2															
NOISE SOURCE/SUBJECT: (OPERATION:) IDENTIFICATION:)															
F-15A AIRCRAFT) OMEGA 3.2															
IN-FLIGHT CREW NOISE) TEST 76-084-001															
) RUN 01															
) 31 MAY 79															
) PAGE F1															
LOCATION/CONDITION															
FREQ	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	1/K	1/L	1/M	1/N	1/O
(HZ)															
25	64	71	86	73	75	76	90	75	80	77	75	74	74	73	74
31.5	62	74	88	74	76	75	91	77	80	80	75	76	75	76	75
40	62	80	82	77	81	81	99	83	88	80	80	81	80	81	81
50	62	78	77	83	81	81	96	80	87	78	76	75	76	77	78
63	70	81	80	92	87	86	102	87	93	86	82	81	82	85	83
80	67	81	85	91	93	94	101	86	91	82	79	78	80	81	81
100	69	83	83	99	100	103	105	88	93	85	82	81	83	83	83
125	68	82	85	90	91	90	100	92	94	50	84	82	84	85	85
160	71	82	86	92	91	91	100	97	99	87	85	85	84	87	87
200	75	83	86	95	93	91	101	100	108	95	91	91	90	92	93
250	73	86	86	94	94	93	100	99	104	97	93	90	92	93	94
315	79	90	88	93	96	95	103	103	103	99	97	92	93	95	96
400	71	88	90	89	93	94	100	101	103	98	95	93	94	96	97
500	70	90	91	88	92	93	99	101	104	99	96	94	96	100	101
630	70	84	88	87	89	91	97	100	104	99	95	93	95	99	101
800	74	80	86	83	85	86	93	99	104	98	94	92	96	99	101
1000	70	78	86	78	81	83	88	95	102	94	91	90	93	97	99
1250	63	77	86	74	79	80	85	94	100	92	88	87	90	94	95
1600	65	77	85	73	78	82	86	94	101	91	89	88	91	95	96
2000	74	77	98	76	79	81	83	91	98	89	87	87	92	94	94
2500	69	76	90	75	78	81	84	98	101	96	92	91	94	96	100
3150	73	77	96	75	79	81	84	97	98	91	89	89	91	93	94
4000	65	77	91	71	81	82	86	89	95	87	88	89	89	91	92
5000	56	79	90	69	82	82	87	92	97	90	90	90	92	93	94
6300	62	72	87	65	77	77	82	87	91	89	89	90	90	91	91
8000	61	75	82	64	79	78	82	85	89	90	91	94	95	93	93
10000															
OVERALL	85	97	104	104	104	106	112	110	114	108	105	103	105	108	109

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													IDENTIFICATION:	
1/3 OCTAVE BAND														
2													OMEGA 3.2	
													TEST 76-004-001	
NOISE SOURCE/SUBJECT:													RUN 02	
F-15A AIRCRAFT													31 MAY 79	
IN-FLIGHT CREW NOISE														
													PAGE F2	
LOCATION/CONDITION														
FREQ (HZ)	1/P	1/Q	1/R	1/S	1/T	1/U	1/W	1/X	1/Y	1/Z	1/AA	1/BB	1/CC	1/DD
25	78	92	87	85	91	91	83	75	75	73	84	72	85	74
31.5	78	90	85	82	89	90	85	79	77	75	86	73	86	74
40	84	92	86	84	89	92	91	82	84	82	88	79	88	79
50	80	88	82	81	85	86	82	78	81	81	84	77	89	79
63	85	88	83	81	86	85	90	85	88	85	92	83	96	86
80	84	87	81	80	84	85	83	82	84	84	88	85	93	84
100	89	88	84	82	86	86	86	86	87	86	88	88	95	89
125	97	89	85	81	87	87	86	85	86	87	88	88	88	87
160	89	88	85	84	88	87	85	84	90	91	90	90	87	84
200	94	90	88	87	90	90	91	93	96	98	96	93	88	84
250	102	92	89	88	92	91	91	95	95	92	96	91	89	85
315	103	95	92	91	94	93	93	98	98	95	98	93	91	89
400	103	98	96	91	95	94	95	99	98	96	99	99	97	95
500	105	98	96	93	97	94	94	99	97	95	97	96	94	93
630	105	94	94	93	96	93	92	96	94	92	94	94	93	88
800	102	92	93	93	96	92	92	93	93	92	91	91	87	82
1000	99	89	87	90	91	88	87	91	88	86	85	87	82	81
1250	99	89	87	90	91	88	87	91	88	86	85	87	82	81
1600	100	90	89	91	93	89	88	92	89	86	85	86	82	81
2000	96	93	88	90	92	91	97	101	94	87	91	87	82	82
2500	101	89	87	94	99	88	89	93	100	93	87	94	81	79
3150	97	89	86	90	92	89	90	89	86	82	85	85	82	79
4000	92	88	86	88	90	87	91	89	84	82	85	84	84	79
5000	94	92	90	92	94	92	93	89	91	88	87	87	84	81
6300	91	94	90	91	94	92	92	89	84	80	86	78	77	73
8000	92	107	102	102	106	107	102	91	85	80	86	78	75	72
10000														
OVERALL	113	116	106	106	109	109	107	107	107	105	106	105	104	108

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

[illegible]

MEASURED SOUND PRESSURE LEVEL (DB)														IDENTIFICATION:	
OCTAVE BAND															
NOISE SOURCE/SUBJECT:														TEST 78-004-001	
(OPERATION:														RUN 02	
(F-15A AIRCRAFT														31 MAY 79	
(IN-FLIGHT CREW NOISE														PAGE J2	
LOCATION/CONDITION															
FREQ (HZ)															
1/P	1/Q	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y	1/Z	1/AA	1/BB	1/CC		
31.5	85	96	91	89	94	96	84	86	85	83	91	81	91	81	
63	88	92	87	85	90	90	87	89	90	88	94	87	98	88	
125	98	93	89	88	92	91	91	92	92	93	94	93	97	91	
250	105	98	94	94	97	96	100	100	101	100	101	97	94	91	
500	109	102	100	97	101	98	103	105	101	110	102	102	100	98	
1000	105	96	96	96	99	96	97	97	95	94	93	94	90	86	
2000	104	96	93	96	100	94	102	98	100	94	93	96	86	85	
4000	99	95	92	95	97	94	94	92	92	99	91	90	88	85	
8000	94	107	102	102	106	107	93	90	87	83	89	81	79	75	
OVERALL	113	110	106	106	109	109	107	107	107	105	106	105	114	110	

MEASURES OF HUMAN NOISE EXPOSURE														IDENTIFICATION:	
3														OMEGA 3.2	
														TEST 78-084-001	
														RUN 01	
NOISE SOURCE/SUBJECT:														31 MAY 79	
F-15A AIRCRAFT														PAGE H1	
IN-FLIGHT CREW NOISE															
LOCATION/CONDITION															
1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	1/K	1/L	1/M	1/N	1/O	
HAZARD/PROTECTION															
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR															
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR															
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)															
NO PROTECTION															
OASLC	85	97	133	104	104	106	112	110	114	106	105	103	105	108	109
OASLA	82	92	103	94	97	97	104	108	112	106	103	102	104	107	109
T	675	120	18	85	50	50	15	8	3.8	11	18	21	15	9	6
HGU-2A/P HELMET WITH H-154															
OASLA*	72	84	86	90	91	91	98	98	102	95	92	90	91	93	94
T	960	480	339	170	143	143	42	42	21	71	120	170	143	101	85
HGU-2A/P HELMET WITH H-154(A)															
OASLA*	68	80	81	87	87	88	94	94	98	91	88	85	86	89	90
T	960	960	807	285	285	240	85	85	42	143	240	404	339	202	170
HGU-2A/P HELMET WITH CUSTOM LINER															
OASLA*	76	89	93	92	94	95	101	103	107	101	97	95	97	101	103
T	960	202	131	120	85	71	25	18	9	25	50	71	50	25	18
COMMUNICATION															
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)															
PSIL	75	86	95	86	89	90	96	102	107	100	97	95	98	102	103
ANNOYANCE															
PERCEIVED NOISE LEVEL; TONE CORRECTED (PNLT IN PNDB)															
TONE CORRECTION (C IN DB)															
PNLT	98	107	121	109	112	113	118	122	126	121	117	116	118	121	124
C	2	1	4	1	1	2	1	1	1	2	1	1	1	1	2

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE															IDENTIFICATION:	
3																
NOISE SOURCE/SUBJECT:															OMEGA 3.2	
(OPERATION:															TEST 78-004-001	
(F-15A AIRCRAFT															RUN 02	
(IN-FLIGHT CREW NOISE															31 MAY 79	
(PAGE H2	
LOCATION/CONDITION																
1/P	1/Q	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y	1/Z	1/AA	1/BB	1/CC	1/DD		
HAZARD/PROTECTION																
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR																
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR																
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)																
NO PROTECTION																
OASLC	113	108	105	104	107	105	107	107	106	105	106	105	104	100		
OASLA	111	108	104	105	107	105	106	105	105	101	102	102	98	96		
T	4.5	8	15	13	9	13	11	13	13	25	21	21	42	60		
HGU-2A/P HELMET WITH H-154																
OASLA*	99	98	93	92	97	96	93	94	93	92	94	91	90	87		
T	36	42	101	120	50	60	101	85	101	120	85	143	170	285		
HGU-2A/P HELMET WITH H-154(A)																
OASLA*	95	86	85	84	87	86	85	89	89	88	89	87	85	82		
T	71	240	404	480	285	339	404	202	202	240	202	285	404	679		
HGU-2A/P HELMET WITH CUSTOM LINER																
OASLA*	176	98	96	96	98	96	96	100	98	97	98	97	95	93		
T	11	42	60	60	42	60	60	30	42	50	42	50	71	101		
COMMUNICATION																
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)																
PSIL	106	98	96	97	100	96	97	100	99	96	96	97	92	90		
ANNNOYANCE																
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PN08)																
TONE CORRECTION (C IN DB)																
PNLT	125	124	120	120	125	123	122	122	119	116	116	118	113	111		
C	1	2	2	2	3	2	3	3	2	3	2	3	1	2		
* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.																

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.